

# Global Innovation Challenge 4: Question and Answers

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## General

1. What is the Technology Readiness Level (TRL) of the solution you are seeking?
  - We are seeking solutions that can be quickly deployed into our operations to address our challenges, after the solution has been validated through the pilot trial. The starting TRL should be 4 or higher, with at least a developed prototype.
2. Who would own the intellectual property (IP) rights after the completion of the project?
  - The default position of PUB is for the participating companies or institutions to own the IP developed from the project, i.e. Foreground IP.
3. Do applicants need to travel to Singapore for evaluation purposes?
  - It is not compulsory for applicants to travel to Singapore for evaluation purposes.
4. If the deployment of a solution requires civil works to integrate it into the network, are the solution providers expected to engage a local contractor?
  - The solution providers are expected to engage their own contractors to complete the works proposed for the pilot trial. In general, we are not keen on solutions that require civil works that would permanently modify our facilities.

## Robotics for Process Tank Cleaning

1. Are there any physical restrictions that could prevent the solution from using access points of the process tank?

- If the solution adheres to physical size limitation of 0.8m by 0.8m, there should be no physical restrictions for the solution to use the access points (both top deck entrance and bottom deck entrance).

2. Can we install supporting structures, such as guide rails, tracks and cable trunking within the process tank?

- Permanent supporting structures are not allowed to be installed within the process tank because we need to keep the area free of obstruction for operations and safety purposes. Temporary structures are allowed during maintenance to support the function of the solution but must be easy to be assemble and disassemble. Please note that drilling or any other actions that could permanently modify tank walls, ceiling and floor are not allowed.

3. Is there a presence of flammable gases in the confined space, and can the solutions be operated electrically?

- Yes, flammable gases may be present in the tank, but the concentration is expected to be below detectable limit when the sedimentation tank is not in operation. We are open to solutions that are electrically operated and there are no restrictions on the power source.

4. How often does the tank need cleaning?

- Approximately once every 6 months

5. Is the solution required to clean both the top and bottom deck?

- Yes, the solution should have the ability to clean both the top and bottom deck. Workers can assist to transport the solution between the top deck and bottom deck.

6. What medium is being used to wash the sludge?

- Water at ~600 kPa is being used to wash the sludge.

7. How is the sludge currently being removed from the process tanks during the cleaning process?

- Currently, the sludge is being removed by spraying water at the sludge to guide it towards the end of the tank where the sludge hopper is located. You may choose to adopt this method for sludge removal or propose an alternative method.

8. Can the sludge be washed off using water without moving the scrapers?

- If the scraper is not moved, the sludge would be contained within sections between scrapers and will not be able to flow out of the sections when sprayed with water. You will need to consider alternative methods to remove sludge trapped in the sections.

9. Does the solution need to be able to move across the scrapers?

- Yes, the solution will need to move across the scrapers to clean the tank effectively. Please note that the scrapers also need to be cleaned as they are part of the areas to be cleaned in the tank.

10. Are there water and power supply outside of the tank, which can be used to supply the solution?

- Yes, water and power supply are available outside of the tank and can be used to supply your solution.

11. Can you provide the drawing of the scrapers?

- The drawing of the scrapers can be downloaded here: [go.gov.sg/gic4-scraper](https://go.gov.sg/gic4-scraper)

12. What material are the scrapers made of?

- Polyester Resin Fiberglass.

13. What is the weight of a scraper?

- 30.7 kg (wet weight)

14. How are the scrapers currently being lifted up?

- The workers will squat down and lift the scrapers with their hands. When there is sufficient opening as shown in the picture below, they will place a support object beneath a scraper. The scrapers will remain attached to the brackets and chains.

13. What are the functions of the brackets and chains that are attached to the scrapers?

- The brackets fix the scrapers to the chains and the chains function to move the scrapers during operations.

15. Can we perform simple modifications to the scrapers?

- Modifications to the scrapers are not allowed.

## Condition Assessment of DTSS Tunnel

1. What are the pipes of DTSS tunnel made of?
  - The pipes are made of reinforced concrete with internal high-density polyethylene (HDPE) lining.
2. What is the thickness of the corrosive protective lining inside the tunnel?
  - The thickness of the corrosive protective lining is in the range of millimeters.
3. Do all the shafts have cast iron opening manholes?
  - Yes, all shafts, both direct and offset shafts have 900mm cast iron manhole openings.
4. Are the tunnels completely filled with water at some sections?
  - Some sections of the tunnel can be 2/3 filled.
5. What is at the end of the DTSS tunnel?
  - The DTSS tunnel eventually leads to the influent pumping station connected to the water reclamation plant.
6. Are there hazardous gases present inside the tunnel?
  - Yes, there are hazardous gases such as hydrogen sulfide and explosive gases such as methane.
7. Is the equipment required to be intrinsically safe or explosion-proof?
  - The proposed solution should be designed to meet both intrinsically safe and explosion-proof requirements. The actual certification can be done after the prototype is developed and verified to be workable.
8. Is the solution expected to cover an inspection distance of 6km in a single operation?
  - 6km is the longest distance between two direct shafts. There are offset shafts (i.e. shafts that are not directly above the tunnel) in between two direct shafts. If the proposed solution can be launched or retrieved via offset shafts, it is not necessary for the solution to cover an inspection distance of 6km.
9. Is traversal required in both downstream and upstream directions, or is only downstream traversal sufficient?
  - We do not require traversal in the upstream direction (but we do not disallow upstream traversal). Downstream traversal is sufficient.
10. Are we allowed to lay tubes or cables onto DTSS tunnel?

- We cannot allow human entry into DTSS tunnel to perform the tubes/cables laying within DTSS tunnel.

11. Can you provide more information about the issues encountered with smart floating balls/buoys

- Smart floating balls/buoys that PUB have encountered in the market are designed for small diameter sewers and not equipped with lights that can illuminate pipes as big as 6m in diameter. These balls/buoys adopt either of the following methods for deployment or retrieval.
  1. Deploy human personnel to enter the upstream manhole to launch the ball/buoy and standby at the downstream manhole to catch the ball/buoy. This method is not suitable as we are looking for solutions that do not require human entry.
  2. The ball/buoy is lowered into DTSS using a pole via the direct shaft and retrieved using a net or grating deployed via a downstream manhole. For this method to be effective, the net or grating need to be customised for DTSS tunnel.

12. Are drawings available for each of DTSS's access point?

- As-built drawings are available. We will only be sharing as-built drawings with the awarded company.

13. Does the report need to comply with any specific norms or standards?

- The report generated for this project can adopt similar format as the conventional sewer CCTV inspection reports.

## Condition Assessment of Used Water Pumping Main

1. How sharp are the bends in the used water pumping mains?
  - Different pumping mains have varying bend angles, such as 22.5, 45, and 90 degrees. However, the typical bends are usually 22.5 and 45 degrees. For the pilot trial, we will share the alignment drawings with the awarded company to provide more details.
2. Are the pumping mains lined with other materials?
  - The pumping mains are typically internally lined with cement. Externally, they may have additional linings such as zinc, bitumen, polyurethane, etc.
3. Does the site identified for the pilot trial have access points to pumping mains such as T-pieces?
  - The identified site for the pilot trial has T-pieces in the pumping main, and the blank flange of the T-piece can be removed to deploy inspection tools or devices.
4. Does PUB regularly clean the pumping mains by pigging?
  - PUB does not carry out pigging to clean the pumping mains.
5. Is the equipment required to be intrinsically safe or explosion-proof?
  - The proposed solution should be designed to meet both intrinsically safe and explosion-proof requirements. The actual certification can be done after the prototype is developed and verified to be workable.